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Capabilities of Future Training
Support Packages

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U.S. Army Research Institute

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14. ABSTRACT *(Maximum 200 words)*:
A training support package (TSP) integrates all the information and materials needed for the successful conduct of a training exercise or event. As the Army transforms to the Future Force, the concept of a TSP needs to transform to make TSPs more accessible and adaptable. This report identifies and analyzes five key capabilities needed in future TSPs: rapid tailoring or modification, reach, simulated operating environment, performance measurement, and pretests/selection criteria. The analysis is based on results of a survey of designers of future training and a review of key acquisition documents for Future Combat Systems. The result is a broadened view of the capabilities needed in future TSPs.

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Capabilities of Future Training Support Packages

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FOREWORD

The U.S. Army is transforming to a Future Force equipped with Future Combat Systems (FCS), and embedded training has been identified as the primary means for training this force. Key FCS acquisition documents indicate that fully embedded training will be achieved through the development and implementation of multi-purpose training support packages (TSPs), integrating all the information and materials required for successful conduct of training events. To meet the needs of Future Force units, TSPs in the future need to be more accessible and adaptable than they are today. The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), particularly its Armored Forces Research Unit (AFRU) at Fort Knox, Kentucky, has been conducting research on structured training and the development and use of collective TSPs to support this training for over a decade. This report builds on this experience in order to address the capabilities that TSPs must provide to meet the needs of the Future Force.

First, this report provides a general description of key capabilities that future TSPs must provide to support fully embedded training for Future Force units. It then provides the results of a survey on these capabilities, followed by a detailed discussion of expanded capabilities needed in future TSPs. The work supporting this report was performed as part of Work Package 212, "Unit Training Technologies for Future Forces." The relevant requirements document is a Memorandum for Record between the Deputy Director, Unit of Action Maneuver Battle Laboratory (UAMBL), U.S. Army Armor Center and Fort Knox, and the Chief, ARI AFRU at Fort Knox, entitled "Research and Development Related to Training Methods for Objective Force Units of Action Equipped with Future Combat Systems," dated 10 September 2002.

The compact disc (CD) supporting this effort was provided to members of the Lead Systems Integrator's Training Systems Integrated Product Team (IPT) and to members of the UAMBL in May 2004. The CD was distributed to support the collection of feedback through a survey instrument and to meet requests of Training Systems IPT and UAMBL personnel. The CD is currently being used by these personnel to demonstrate future TSP capabilities to designers and developers of Future Force training. The results documented in this report were provided to Training Systems IPT and UAMBL personnel on 22 September 2004. They are using these results to develop and refine capabilities needed in Future Force TSPs.

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Acting Technical Director

CAPABILITIES OF FUTURE TRAINING SUPPORT PACKAGES

EXECUTIVE SUMMARY

Research Requirement:

As the Army transforms to a Future Force equipped with Future Combat Systems (FCS), embedded training has been identified as a Key Performance Parameter. Fully embedded training will be developed and implemented through multi-purpose training support packages (TSPs). These TSPs will integrate all the information and materials required for conduct of successful training events. To enable the embedded training of Future Force units, TSPs need to be more accessible, adaptable, and manageable than they are today. This effort identifies and analyzes the key capabilities that future TSPs must provide in order to meet these needs.

Procedure:

Based on review of key FCS acquisition documents, the authors of this report identified five general capabilities that future collective TSPs should provide. A compact disc (CD) demonstrating these capabilities was then produced through a supporting contract effort. The authors distributed this CD to personnel involved in the design and development of embedded training for the Future Force, along with a survey on future collective TSP capabilities. They then used the results of this survey and a review of updated acquisition documents to further analyze and broaden the description of key capabilities needed in future TSPs.

Findings:

To achieve fully embedded training for the Future Force, future TSPs must provide supporting capabilities through the framework of a training management system. The key capabilities that must be provided, in rank order of importance, are: rapid TSP tailoring or modification, bi-directional reach, a simulated operating environment, semi-automated performance measurement, and pretests or selection criteria for entry into a training event. These capabilities are similar to the Training Common Components (TCC) identified as part of FCS embedded training acquisition, except the TCC do not address the need for reach.

Utilization of Findings:

Managers of the development of embedded training for the Future Force (including senior personnel within the Lead Systems Integrator's Training Systems Integrated Product Team and the Unit of Action Maneuver Battle Laboratory) are using the CD produced in this research effort to demonstrate future TSP capabilities needed to training developers in proponent schools and supporting contractor organizations. This report provides a broadened view and description of these capabilities, along with a ranking of their relative importance. This will help ensure that embedded training in general and collective TSPs in particular are developed to provide the key capabilities needed for effective training of the Future Force.

CAPABILITIES OF FUTURE TRAINING SUPPORT PACKAGES

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CAPABILITIES OF FUTURE TRAINING SUPPORT PACKAGES

Over the past decade the concept of integrating all the information and materials needed to support a training event or exercise into a training support package (TSP)[1] has evolved considerably in the Army. While it's not clear exactly where or when the term "TSP" was first used, extensive delineation of the elements of a collective TSP and approaches to integrating and packaging them occurred during a series of research and development projects conducted by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) at Fort Knox, Kentucky, during the 1990s. These projects developed methods for what has come to be known in the Army as structured training, initially for the Virtual Training Program and the Force XXI Training Program (Campbell, Quinkert, & Burnside, 2000). The TSP definition aspect of these projects culminated with a comprehensive listing of the components or elements of a TSP for a collective training event (Gossman, Graves, Mauzy, & Clagg, 2001). The U.S. Army Training and Doctrine Command (TRADOC) has incorporated this listing into updates of its regulatory guidance for training management, processes, and products (Department of the Army (DA), 1999).

Army leaders have recognized the importance of training in the ongoing transformation to the Future Force by making embedded training a Key Performance Parameter (KPP) in the acquisition of Future Combat Systems (FCS). This means that the transformation to a Future Force equipped with FCS will not be achieved successfully without meeting KPP 6, stated as follows: "The FCS family of systems must have an embedded individual and collective training capability that supports live, virtual, and constructive training environments" (Unit of Action Maneuver Battle Laboratory (UAMBL), 2004, p. 43). Key FCS acquisition documents, including the Operational Requirements Document (ORD; UAMBL, 2004) and the Operational and Organizational Plan (O&O; TRADOC, 2004a), clearly state that embedded training will be the primary means of conducting Future Force training, and that future embedded training capability will be achieved through development and implementation of TSPs. For example, the O&O states that "TSPs will be developed to support individual tasks through Unit of Action (collective) tasks…" (TRADOC, 2004a, p. 175). The ORD states that "The FCS family of systems must be fielded with a full set of multi-purpose, individual and collective TSPs for use at institutions, in the self-development program, and in operational units…" (UAMBL, 2004, p. 64). To meet this requirement, the Lead Systems Integrator (LSI) for the FCS family of systems has initiated a multi-year effort to develop collective TSPs for Units of Action equipped with FCS. The collective task analysis supporting this effort is currently ongoing. It thus appears that TSPs will be at least as important to Army training in future decades as they have been in the past decade.

It seems likely that as the Army transforms to the Future Force, the concept of a TSP must transform also. Large paper-based volumes of training support materials will not meet dynamic training needs and distributed access requirements of the future. The purpose of this paper is to examine how the concept of a TSP needs to change to address the training (primarily embedded) needs of the Future Force, along with implications for the development and implementation of future TSPs. The focus is collective TSPs, particularly those supporting command and staff exercises, but there should be implications for all types of TSPs. First, the

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[1] A list of all acronyms used in this report is included in Appendix A.

history and traditional perspectives of TSPs are examined briefly. Then, the general capabilities that TSPs must provide to support Future Force collective training are discussed, primarily in terms of training management and five selected capabilities for which a demonstration has been developed (see inside back cover of this report). The results of a survey administered to Future Force training designers in conjunction with this demonstration are then presented, followed by further analysis and discussion of the capabilities that collective TSPs must provide for the successful implementation of future embedded training.

Traditional Concept of Training Support Packages

Lessons Learned from Structured Training

The traditional concept for a TSP is a very simple one – provide all the information and materials needed to support a training event or exercise in one integrated package. During the aforementioned series of research and development projects on structured training in the 1990s, one lesson learned was that collective TSPs can become very complex. This is due to the sheer volume of materials that may be required for a training event, as well as to the sometimes complex interrelationships among TSP components.

Campbell, Campbell, Sanders, Flynn, and Myers (1995) provided the first comprehensive description of the components of a collective TSP. These included preparation materials for the training unit, execution materials for trainers and training managers (including observers and controllers), training performance data collection and feedback materials, and summary report materials supporting feedback to the training unit's leadership. The concept of including all required materials for the training unit and the training staff in one package led to the production of shelves full of paper-based TSPs. It also led to issues in the management of voluminous paper-based materials. How can all training participants be provided ready access to all materials they need, while minimizing duplication? Answering this question led to the identification of two types of TSP packaging – a "shelf" version or master set from which copies are made, and a "distribution" set of copied materials for training participants (Campbell & Deter, 1997). Providing all participants in a training event with ready access to all materials they need may be more easily achievable today and in the future. Further discussion of this is included later in this paper.

In addition to concerns about packaging, several other considerations were key from the beginning of the development of collective TSPs for structured training. Since the training developed was virtually all simulation-based, it was necessary to include in the TSPs detailed information for initializing the simulation exercises, such as starting locations and routes for simulated entities. Plans and operations orders were generally prepared in advance to allow training units (primarily Army National Guard units) to enter into training of task execution rapidly. It was thus necessary to include such materials in the TSPs, along with preparation and reference materials to help units "read into" upcoming exercises. The TSPs also included detailed instructions for a dedicated staff of trainers or observer/controllers (O/Cs). An initial focus of structured training was after action reviews (AARs) and ensuring that exercises were designed to allow O/Cs to bring out selected key points during such reviews. Performance measurement, at least in the form of organized checklists for observing complex behavior, and

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feedback were thus key considerations early in the development of TSPs. Yet another consideration was minimizing the number of and burden on supporting staff (e.g., personnel portraying higher headquarters or opposing forces) necessary for a training exercise. The TSPs had to include information to facilitate the participation of such role-players.

One consideration that arose early in the development of TSPs for structured training deserves special mention here. The TSPs included operations orders, training objectives (in terms of tasks to be performed in each exercise), and other documents to minimize the materials that participating units needed to prepare. But from the beginning of unit trials with structured training exercises, unit leaders expressed a strong desire to be able to modify or tailor TSPs and exercises to more precisely meet their needs. This varied from a desire to insert unique unit names and call signs to a desire to change training objectives and address additional tasks. As structured training evolved from the initial Simulation Networking virtual environment to the Close Combat Tactical Trainer (CCTT) environment, ARI conducted a series of projects to develop the Commanders' Integrated Training Tool (CITT; Flynn et al., 2001), sponsored by the Project Manager and the TRADOC System Manager for the Combined Arms Tactical Trainer. The CITT was a large software package designed to assist unit leaders and other trainers in modifying existing TSPs or even developing their own TSPs for unique training requirements. The development of TSPs for different training environments also led to recognition of the need for a capability to modify TSP components rapidly for implementation in varied environments. Any effort to develop TSPs must include a means for tailoring them rapidly for user and environmental reasons. It should also include recognition that provision of a tool for authoring or modifying TSPs is far from a simple undertaking; TSP components have many interrelationships, and changing one component can impact on many others.

Based on experience gained during development of structured training and recognition that TSPs would increasingly be produced by users (institutional instructors and unit leaders) in the future, Gossman et al. (2001) addressed the management of user-produced TSPs. Part of this effort involved a comparison of collective TSP components or elements from various sources, along with preparation of a comprehensive consolidated listing. A list of almost 300 elements that might be included in a collective TSP (not all TSPs would include all elements) was generated, organized in the following general areas:

- TSP Identification
- Exercise Overview
- Tactical Materials
- Exercise Control Materials
- Exercise Set-Up Materials
- Evaluation Plan
- Administrative Materials

Before moving on to discussion of the current definition of a collective TSP, one final historical point should be made. Over the years many personnel newly introduced to the concept of a TSP seem to have had difficulty distinguishing between a TSP and the event or exercise it supports. This is understandable since the two go together; a TSP facilitates the conduct of an effective training event. Basically, a TSP is the total information (recorded in paper and

electronic forms) necessary for a training event or exercise to be conducted in a way that meets its objectives. An analogy might be completing a resident academic course by reading a textbook and completing other supporting activities, and then attending class and demonstrating proficiency by taking a test or other means. Sound educational procedures generally require both. Sound training procedures require integrated support materials (generally in the form of a TSP) and an event providing an opportunity for the training audience to perform, with feedback provided on the process and the result.

Formal Definition of a Training Support Package

The current version of TRADOC Regulation 350-70 defines a TSP as follows: "a complete exportable package integrating training products, materials, and information necessary to train one or more critical tasks…contents will vary depending on the training site and the user." (DA, 1999, Para. V-7-3). The regulation goes on to distinguish between individual, collective, and Army Modernization Training TSPs. It then provides the following complete definition of a collective TSP:

> "A complete, stand alone, exportable training package integrating training products and materials needed to train one or more critical collective tasks and supporting individual tasks (including leader and battle staff). It is a task-based information package that provides a structured situational training scenario for live, virtual, or constructive unit or institutional training." (DA, 1999, Para. V-7-4).

The TRADOC regulation makes a distinction between collective TSPs in general and one type called "Warfighter" TSPs by stating that the latter supports training for all units (digital as well as analog), whereas the former may not. In the case of Future Force TSPs, it seems that the appropriate corresponding point is that these TSPs must support training with a variety of systems and units that are not FCS-equipped, including joint, interagency, and multinational (JIM) elements. Future Force TSPs for unit or team exercises could thus be referred to as Warfighter TSPs; in this paper they will be referred to simply as collective TSPs.

There are several other points made in TRADOC Regulation 350-70 (DA, 1999) that are particularly relevant to this paper. One is that TSPs are prepared for the unit commander to minimize unit preparation time and measure unit performance. Another is that TSPs vary greatly in content depending on the tasks to be trained, the training environment, and the training audience. Yet another is that TSPs include pre-exercise event generation information, which in simulation-based training equates to the initialization information mentioned earlier. A final key relevant point is the recognition of the need for tailoring TSPs, noting that "TSPs are subject to constant modification by the unit" (DA, 1999, Para. V-7-4m). The regulation indicates that quality control must be maintained in TSP development and tailoring, without specifying how this is managed.

The regulation also includes a listing of the components of a collective TSP, similar to the list provided by Gossman et al. (2001). It appears that the TRADOC listing has changed somewhat over the past few years, but not in a major way. There now appears to be a generally

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accepted definition of a collective TSP and listing of its potential components throughout the Army, as documented in TRADOC Regulation 350-70 (DA, 1999).

Concept of Future Training Support Packages

Future Implementation of Embedded Training

A detailed description of the Army's ongoing transformation to a Future Force will not be provided here, since it is available from many sources (e.g., TRADOC, 2004a; UAMBL, 2004). The Army will be spirally transforming over the next decade into a force that can readily perform a wide range of operations in a variety of environments. Characteristics to be possessed by this force are that it will be responsive, deployable, agile, versatile, lethal, sustainable, and able to provide survivability, enabling it to see first, understand first, act first, and finish decisively. Key to achieving this transformation will be development and fielding of the FCS, a family of systems including manned and unmanned ground and aerial platforms, sensors, and information networks. These networks will support knowledge-based operations, including battle command.

One key aspect of the Army's transformation that will be examined in detail here is the plan to implement embedded training as the primary training method. The current version of the O&O indicates that the Future Force training strategy "emphasizes training via embedded training linked to the live, virtual, and constructive domains" (TRADOC, 2004a, p. 168). The O&O also states that "embedded training is the keystone concept for FCS training" (p. 169) and that "Embedded training must support all essential tasks unless they do not lend themselves to embedding because they are unsafe, impractical, or unaffordable" (p. 170). The ORD also clearly identifies the requirement for embedded training: "The foundation of the FCS training concept is a fully embedded training capability" (UAMBL, 2004, p. 80).

Before examining the underlying capabilities needed in Future Force collective TSPs to achieve a fully embedded capability, it is necessary to define embedded training and how it will be implemented. The Users' Functional Description (UFD) for Future Force embedded training defines it as "a function hosted in hardware and/or software, integrated into the overall equipment configuration" (TRADOC, 2004b, p. 3). In an earlier report the present authors provided a similar definition of embedded training as "training provided by capabilities built into or added onto operational systems to provide, enhance, and maintain the skills, knowledge, and abilities necessary to enable task performance" (Throne & Burnside, 2003, p. 16). This latter definition will be used for the purposes of the present report.

If it is to be successful, embedded training will be implemented as an inherent capability of the FCS family of systems, rather than as a function peripheral to operational platforms. It is thus best to think of future training as being embedded in operational networks, rather than on platforms (see Throne & Burnside, 2003, for further discussion of this point). Embedded training software will reside on operational platforms as needed, but a fully embedded capability will only be achieved through the power of large knowledge networks. Embedded training software (including TSPs) will be downloaded as needed onto operational platforms and other network portals, such as desktop and tablet computers, and where TSPs reside should be largely

transparent to users. This will enable training anywhere, anytime, on operational equipment or other devices that are available and appropriate.

In order to achieve a fully embedded capability, TSPs will be implemented in various forms. The O&O (TRADOC, 2004a) identifies three forms: computer-based interactive courseware for individual training (usually called interactive multimedia instruction or IMI), simulation-based TSPs for individual and crew operations, and simulation-based TSPs for collective training of units, leader teams, and staff groups. Materials developed by the FCS LSI (LSI, 2004) identify three somewhat different types of TSPs: IMI, simulation-based TSPs for tactical task proficiency, and interactive electronic technical manuals (IETMs) for individual operations and maintenance training. The present paper will use LSI's break-out and focus on collective simulation-based TSPs at all levels, individual[2] to Unit of Action.

The LSI's identification of IETMs as a type of individual TSP brings up another point addressed in detail by Throne and Burnside (2003). Generally IETMs may be considered a simple type of electronic performance support system (EPSS), with EPSS defined as a computer-based system that includes access to information, guidance, advice, assistance, training, and tools to enable performance with minimum support from other people (Gery, 1991). Think of EPSS as an integrated, effective help system that sustains performance, while embedded training supports the initial acquisition of skills and knowledge enabling performance. As training becomes available anytime anywhere in the future, the distinction between EPSS and embedded training will continue to blur. Achieving the ambitious performance goals for Future Force Soldiers and leaders will require the complete integration of EPSS and embedded training. Embedded training and EPSS will reuse many common elements. Embedded training may largely become practice (with feedback) on using EPSS tools, with a gradual "weaning" of performers from reliance on these tools. This will result in speeding of performance, much like we become more facile with complex software packages today as we use them and come to rely less on tutorials and help. If a Soldier or leader continues to demonstrate inadequate performance, EPSS may direct him or her back to retake a module of embedded training. Embedded training and EPSS will thus be implemented hand-in-hand.

One final point that should be made here regarding the implementation of embedded training is that it will not support the training of all tasks. Some tasks may be unsafe (e.g., initial platform driving), unreasonable (e.g., digging foxholes), or not cost-effective (e.g., basic dismount operations) to train through embedded training. Operational Future Force networks will provide access to information on how to perform and train such tasks, but practice with feedback will not be accomplished on operational systems. Also, operational networks and platforms may not be available for training at all times and places. While the time spent in resident training at centralized training institutions is likely to decrease in the future, there will still be a need for at least initial or basic training at such sites. Since availability of operational systems is likely to be limited for basic training sites, devices and simulations will be needed. The O&O (TRADOC, 2004a) describes such devices as networked reconfigurable, full-task trainers (NRFTT), part-task trainers, and desk-top trainers. A key point here is that embedded

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[2] An individual can train in a simulation-based collective exercise if all other participating elements are simulated; more on this later.

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training software that functions on operational systems must also function on NRFTT and part-task or desk-top trainers. This will allow realistic training when operational systems are not appropriate or available for training. For example, it is likely that at least initial battle command training can be completed on desk-top trainers (computers) that work like (i.e., use the same Warfighter Machine Interface (WMI) as) operational networks.

Again, the focus of this paper is simulation-based, collective exercises conducted over operational networks and/or networks of devices, with from one to a large number of participants. On operational networks Soldiers and leaders will log into a training mode (they may actually be in training mode most of the time) and complete training exercises much as they perform real-world operations. Full simulation capabilities, including computer-generated forces and AAR support, will be available almost all the time on operational systems, no matter where the systems are located. The details of how this will work will not be addressed here, as those are currently being delineated by LSI personnel. The remainder of this paper focuses on specific TSP capabilities needed to achieve the future embedded training vision.

Training Management System

When reviewing FCS acquisition documents such as the ORD (UAMBL, 2004) and the O&O (TRADOC, 2004a) to identify TSP capabilities needed, training management issues quickly come to the fore. The following question arose quickly while analyzing TSP capabilities for this paper: Is that a capability of TSPs or of the larger training management system within which they reside? It appears that the answer in many cases is both. Just as TSPs are inseparable from the events or exercises they support, they are also inseparable from the training management system within which they are developed and implemented. The FCS embedded training system of systems must integrate many functions or services, including TSPs, training management, WMI, available delivery media, and EPSS. While exactly where a particular function or capability resides may be of interest to system designers and engineers, it is generally transparent and of little relevance to users. Therefore, in the remainder of this paper, only limited discussion is included relating to whether a needed capability should reside in the TSPs themselves versus in the overlying training management system or elsewhere.

Provision of an integrating management framework or infrastructure is critical to the development and implementation of Future Force TSPs. The future training management system must be developed by TRADOC, the Army's primary training manager, based on experiences with legacy systems, such as the Automated Systems Approach to Training (ASAT). It should be noted that teams initiating development of Future Force collective TSPs are working with an early version of TRADOC's Training and Doctrine Development Tool (TDDT, a successor to ASAT). While many details of the future training management system remain to be worked out, it will be developed within integrated architectures, such as the Army Training Information System (ATIS). The UFD for embedded training (TRADOC, 2004b) indicates that this will be achieved through a Training Support System (TSS) accessed via a reach (two-way distance communication) capability. The development of the training management or support system must stay ahead of the development of TSPs, in order for the embedded training system of systems to provide the capabilities discussed in the remainder of this paper.

Key FCS acquisition documents identify several embedded training capabilities that will exist primarily in the training management system or services. For example, the O&O (TRADOC, 2004a) discusses the updating and upgrading of TSPs as operational systems are reconfigured and fielded. A general training management capability will be needed to automate updates linking IETMs and technical data to the training process. Another training management capability that will continue to be needed in the future is the identification and justification of required training resources within combined arms (and JIM) training strategies. Management services will also be needed to synchronize TSP versions with equipment, software, and organizational design versions. The previously discussed packaging of TSPs to enhance accessibility would also seem to be predominantly a training management function.

The LSI and government managers of FCS acquisition have also recognized that a training management system is critical to achieving fully embedded training capability for the Future Force. Training and exercise management is included in an evolving list of seven or eight integrated training software applications and services (called Training Common Components or TCC) that will provide required functionality or infrastructure for embedded training (Harrison, 2004; LSI, 2004). Plans call for the FCS training management system to be a reusable application adapted from the ATIS, supporting activities such as development of mission-essential task lists, development of training strategies, planning and scheduling of training events, and recording the results of training. Required training management or support capabilities are discussed further below in the context of more specific TSP capabilities. The relationships of needed TSP capabilities to the TCC are examined further in a later section of this paper.

Selected Future Training Support Package Capabilities

In early 2003 the present authors initiated a contract with Human Resources Research Organization to develop a prototype or exemplary collective TSP for the Future Force (ARI, 2003). One of the general points made in the Statement of Work (SOW) for this project was that TSPs will not be paper-based in the future. They rather will consist of elements in databases or other electronic repositories that are pulled together as needed to support specific training needs. A unit leader may identify a training requirement in terms of tasks that need to be practiced by a specific training audience, and the training management/support system will create or pull together materials needed for conduct of a training exercise and deliver tailored materials electronically to participants. Future Force TSPs thus represent a very dynamic rather than a static concept. The SOW used the term "electronic TSP (eTSP)" to represent this concept; other possible terms for future TSPs will be discussed in the final section of this paper.

Based on review of available FCS acquisition documents at the time, the authors of the SOW (ARI, 2003) described five capabilities to be included or demonstrated in the exemplary Future Force TSP. One was enabling Soldiers or leaders to reach to central repositories or experts for assistance or training support. For example, a Soldier demonstrating performance difficulty might drop out of a collective training exercise and reach to an institutional repository to complete remedial individual training before returning to the exercise. Soldiers and leaders should be able to reach to central information repositories, subject matter experts (SMEs), or training developers at the Home Station Operations Center (HSOC) or TRADOC centers and

schools for further assistance and training support. Access to JIM resources should also be available.

A related capability was the inclusion of pretests or specified entry criteria in the TSP, so that the training management system could assess whether Soldiers and leaders had completed individual training requirements allowing them to be prepared to participate in collective training. If a participant has not met the criteria for inclusion in a particular exercise, the commander should be able to: inform and help the participant to meet the criteria before the scheduled exercise, select a different exercise, or override the system and let the participant be included without meeting the necessary criteria.

Another related capability described was that future collective TSPs will include access to intelligent agents that can substitute for members of the training audience who are completing individual training or not available for other reasons. Leaders will thus be able to specify which participants in an exercise are actual unit members and which are represented through intelligent semi-automated forces (SAF) or other means, allowing training to be conducted with any number of unit members available. For each unavailable member, the commander will have several options, including: continue with a human replacement, continue with an agent/avatar or computer-generated replacement,[3] continue with no replacement (this will exclude that team member's role entirely, and the training system would adjust the exercise accordingly), or discontinue the exercise entirely.

The SOW (ARI, 2003) identified semi-automated performance measurement and feedback as another key future TSP capability, primarily to facilitate AARs. The automated performance measurement tools will link performance data directly to training tasks and standards. Additionally, the entire AAR, along with the performance data, will be recorded and saved for future use. The performance measurement tools will also provide the embedded training system with the capability to continuously assess participant performance and identify instances of inadequate or poor performance by monitoring the actions of the participants and, using intelligent agents, comparing those actions to reasonable or expected actions. If a collective exercise participant is performing poorly, the commander will have several options for intervention, including: continuing the exercise while providing coaching, removing the participant from the exercise and providing tutoring while temporarily replacing the team member with an agent, or pausing the exercise for everyone and conducting a short AAR.

The final TSP capability identified was the inclusion of tools enabling rapid tailoring or modification of training materials and exercises to meet the anticipated dynamic requirements of the Future Force. Leaders will then be able to gain rapid access to training support materials tailored to the specific needs of their unit and mission. To provide this capability, an exercise modification routine will be needed to identify, retrieve, modify, and update all of the relevant TSP elements requiring modification. The routine will need to be able to carry out the desired modifications to the TSP throughout all required databases, and for those that need human intervention, it should provide step-by-step guidance and cues (i.e., electronic performance

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[3] In the near future, avatars will simulate missing team members in a limited manner, predominantly based on Objective OneSAF (semi-automated forces) capabilities.

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support). A management capability will also be required to make sure that all changes made are compatible with the rest of the TSP and the exercise it supports.

The eTSP project resulted in a demonstration or illustration of the five future capabilities described above, in the context of a training management system. This demonstration was produced in the form of a compact disc (CD; Gossman, Flynn, & Breidenbach, 2004), which is included inside the back cover of this report. The CD explains and illustrates the five capabilities, but it does not provide software enabling the capabilities to function in an interactive manner. Primarily through the FCS Integrated Product Team for Training Systems, the CD was provided to numerous personnel involved in the design and development of Future Force TSPs. A survey form was included with the CD, in order to gather feedback on the capabilities demonstrated and additional ones that might be needed. The results of that survey are described in the next section. This is then followed by further examination of future TSP capabilities needed, in the light of the survey results and analysis of FCS acquisition documents as they have been revised over the last two years.

Survey on Future Training Support Packages

Survey Instrument and Procedures

A short, five-question survey (see Appendix B) was designed to be filled out after participants viewed the eTSP CD. Participants were first asked to rank order the five capabilities, with "1" being the most important, and explain why it was considered the most important. Then they were asked whether the capability they ranked last was "really important" or "nice to have, but not really important" and why. Next they were to list any additional capabilities that will be important to include in TSPs for Future Force collective training. Finally, they were asked to identify the biggest challenge(s) in providing TSPs rapidly to meet the collective training needs of Future Force units.

Approximately 75 CDs with surveys were distributed based on the requests received. Due to the high demand, only one copy of the CD was mailed to each agency, even if there was more than one request from that agency. Instead, participants were asked to share the single copy with their co-workers. Three weeks after the CDs and surveys were mailed, a follow-up e-mail was sent to everyone who requested a copy reminding them to return the survey. An electronic version of the survey was attached to the e-mail so people could fill it out on their computers if desired.

Survey Results

Of the 75 surveys distributed, 21 were returned (28% return rate). Table 1 shows the rankings received for each demonstrated TSP capability. Rapid tailoring or modification was rated as the most important capability for Future Force collective TSPs. Those who gave it the highest ranking gave various reasons. One participant felt that a rapid tailoring capability would make future TSPs more user-friendly and adaptable. Another thought that it would allow for more hands-on training time rather than spending that time making changes. Finally, a third participant wrote, "Having the ability to change scenarios/players will keep training

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fresh/interesting. Most embedded software is quickly memorized and becomes boring." This capability was not given the lowest ranking by any of the participants.

Table 1

Rankings for Initial TSP Capabilities

TSP Capability	Ranking					
	1	2	3	4	5	Mean
Rapid Modification	11	3	3	4	0	2.00
Reach	6	8	3	1	3	2.38
Intelligent Agents	1	6	4	6	4	3.29
Performance Measurement	2	0	8	6	5	3.57
Pretests & Selection Criteria	1	4	3	4	9	3.76

The reach capability was a close second in rankings. Several participants who ranked it as the most important capability gave a practical reason for their ranking: if training data are contained in central repositories, then training cannot be conducted if the data (including TSPs) cannot be accessed. The three participants who gave reach the lowest ranking agreed that it was still a "really important" capability. As one participant wrote, "…the database for scenarios must be huge and therefore cannot be resident in the Soldier's tactical equipment. Also, scenarios must be updated…Reachback is the most efficient way to accomplish this."

The other three capabilities were closely grouped together in their rankings. Only one participant felt that the use of intelligent agents to substitute for missing team members was the most important capability. Most felt it fell somewhere in the middle of the other capabilities. Two of the participants who gave the lowest ranking to the use of intelligent agents to substitute for missing team members said it was "really important" while the other two said it was "nice to have, but not really important." When asked to explain their lowest ranking, both participants who thought intelligent agents were really important wrote that when some participants are not available for a collective exercise, learning is delayed for those who are available. Those who rated agents as nice to have felt that agents could not accurately simulate human behavior and as a trainer, one would want the critical players involved in the training.

While two participants ranked automated performance measurement tools as the most important capability, most ranked it toward the bottom. Those who gave it the lowest ranking were divided, with two participants saying it is "really important" and three rating it as "nice to have, but not really important." According to one of the participants who gave it the lowest ranking, "…this is critical to implementation of the 'training progression matrix' and greatly enhances the O/C's capability to provide value added AARs."

Finally, pretests and selection criteria received the lowest ratings of the five capabilities. Only two of the nine participants who gave it the lowest rating thought it was "really important," while the other seven said it was "nice to have, but not really important." One of the participants

who thought it was nice to have wrote, "The leader should already know his troops' qualifications and although training progression is preferred, it does not hurt to be thrown into the frying pan and tested beyond your comfort zone." Several of the other participants agreed with this sentiment.

Several participants listed descriptions of additional capabilities needed in future collective TSPs. Two mentioned the need for central updating to maintain the validity of TSP content, and two others mentioned the related need for an archive or feedback system to identify updates needed to training managers or proponents. Two participants indicated that TSPs should provide a thorough understanding of all the capabilities available to the Future Force, particularly the myriad of sensors expected to be available. Two others mentioned the need for online training aids or help to ease the preparation and execution of training exercises. Finally, one participant listed the need for TSPs to have the capability to configure and initialize operational vehicles as well as simulated entities. These are all important capabilities that will need to be in or accessible from future TSPs, but it may be that they can be developed within a generalization of the five capabilities addressed explicitly in the survey. This is discussed further in the next section of this paper.

Almost all the participants listed what they saw as a few of the biggest challenges to providing TSPs rapidly to meet the collective training needs of the Future Force. Some of the most commonly mentioned challenges included: creating the numerous scenarios that will be needed as well as altering, modifying, tailoring, and updating them; getting the bandwidth that will be needed to support exchange of training information; providing adequate training infrastructure to support the use and maintenance of TSPs; standardizing content within central repositories; structuring TSPs so they will configure or initialize operational platforms; and finally, connectivity between future and current forces and Combat Training Centers.

Broad Capabilities Needed in Future Training Support Packages

Reviews of current versions of FCS acquisition documents and the results of the eTSP survey indicate that the five capabilities identified previously (ARI, 2003) are key ones needed to support collective Future Force training. No major new capabilities have been identified. However, analysis of acquisition documents and survey results has identified additional functions or services that need to be accomplished within the "big five" capabilities. These capabilities thus need to be broadened and refined to incorporate all required functionality. The five broadened capabilities are discussed below in order of their survey ranking, with training management issues integrated throughout rather than discussed as a separate topic. This is followed by a discussion of the relationship of the five capabilities to the TCC.

Rapid Tailoring or Modification

Respondents to the eTSP survey agreed with a view frequently expressed by leaders of units participating in structured training exercises – TSPs prepared for a unit must be readily modifiable by unit personnel. Current versions of FCS acquisition documents also stress the importance of tools for tailoring TSPs. For example, the O&O includes a means to modify TSPs in a list of key embedded training capabilities, and describes this capability as follows: "Tailor

training based on the users' needs, performance, and choice as appropriate. This includes the capability for leaders to tailor training exercises to meet unit needs" (TRADOC, 2004a, p. 172). The ORD states a requirement for an authoring tool for developing new TSPs or modifying existing ones (UAMBL, 2004). It thus appears there is a consensus that tailoring or modification is an important, if not the most important, capability needed in future collective TSPs.

Reasons for tailoring. There may be various reasons for tailoring a TSP. The most commonly noted one is to meet units' needs or unit leaders' desires. It will never be possible to identify every possible future training requirement, let alone develop every TSP that a unit might need. This is even more true for Future Force units expected to be trained and ready to conduct a full spectrum of operations. Since a complete repository or library of TSPs potentially needed will not be available, unit leaders will need to access and modify TSPs rapidly to meet their dynamic training needs. They will need a means to locate and access the available TSP most closely fitting their needs, determined through criteria such as the missions to be performed, the tasks to be trained, and the training environment to be employed. They will then need straightforward tools or aids (EPSS) to guide them through the sometimes difficult modification process. A primary function of these tools will be to ensure that changes made in one element of a TSP are reflected appropriately in other elements. For example, the addition of a task to be trained may cause additions or changes to orders, objectives, measures, AAR guides, etc.

It will also be desirable to modify a TSP based on a unit's training history or performance during previous training or operational events. This may be based on the choice of a commander higher than the training unit's leader. For example, if a unit has done especially well on a particular type of training exercise in the past, a higher commander may want to make the conditions more challenging. Or he may want to do the opposite if the unit has performed poorly in the past. Also, a commander may want to modify or create a TSP based on actual operations that a unit has experienced recently. Eventually a training management system may be powerful and intelligent enough to recommend training events and tailor TSPs for units based on their training and operational performance history. This will provide full support for a progressive or "crawl-walk-run" approach to training.

Another reason for modifying a TSP that merits further discussion here is the characteristics of the available training environment or delivery media. The most common environment for conduct of collective training exercises in the Future Force is intended to be operational networks and platforms, but these will not always be available. Collective TSPs must thus be developed for fully embedded exercises, but they should be readily adaptable for training via other means, such as NRFTT and desk-top trainers. Thus, TSPs should include tools for readily (automatically at some point in the distant future) adapting themselves and the supported training events to the major collective training delivery environments expected to be available to the Future Force. These may include live, virtual, and constructive embedded training exercises, as well as NRFTT, desk-top trainers, laptop or tablet computers, and other non-embedded training means.

Future Force TSPs must also have the capability to adapt to the synthetic natural environment within which collective exercises are conducted. This includes the database representing terrain and features on it, as well as weather and illumination conditions. In the past

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it has not been a simple matter to adapt a TSP from one terrain database to another, or from day to night conditions. Lessons learned from the CITT projects indicated that changing a TSP from one terrain database to another was as complex as creating a new TSP (Gossman et al., 1999). Modifications to the synthetic natural environment need to be facilitated and eventually automated by TSP tailoring tools. Another key aspect of the training environment for Future Force exercises will be the systems operating within it. Future Force units will increasingly conduct training exercises with elements equipped with complementary or non-FCS systems, as well as JIM elements. The TSPs for such exercises will need to adapt for the participating systems or elements.

The tailoring or adaptation of TSPs for all the reasons listed above should as much as possible be automated as part of a training management system rather than left to be worked out by personnel in participating units. Leaders should be able to specify key parameters, such as tasks to be trained, participating elements, and desired conditions (including terrain database and weather), resulting in provision of an appropriate TSP as painlessly and rapidly as possible. The need to adapt to a multitude of increasingly complex training environment factors in the future indicates that the provision of tools for tailoring of TSPs will not be a simple undertaking.

Degree of tailoring. A key management issue in the tailoring of future TSPs will be the extent or degree of tailoring that unit leaders and other personnel are allowed to accomplish. One aspect of this will be the maintenance of standards to ensure quality control of TSPs. A central agency (probably TRADOC) will need to provide policies for and monitor the production and tailoring of TSPs to ensure they contain all elements required to lead to a successful training event. This agency will also need to maintain a repository of TSPs so that units have ready access to them, including a means to search rapidly for the TSP closest to meeting units' training needs. A primary consideration in managing this repository will be the means for determining whether a tailored TSP represents a new TSP that should be made available to all units. What degree of variation will qualify a TSP for entry as a new item in the repository?

It seems unlikely that unit personnel will ever create a new TSP "from scratch." Rather, they will start with a template and probably with an available TSP that most closely meets their needs. It may thus not be necessary or wise to make TSP creation tools generally available to units. For reasons of quality control and time available, it may be wise to limit the degree of tailoring that can be accomplished by unit personnel. Extensive tailoring should perhaps be accomplished by supporting elements with sufficient time and resources available, such as an HSOC or a TRADOC institution. This is discussed further below, following a summary of experience with a relevant software package, CITT.

Experience with CITT. The primary historical example of a system supporting the creation and modification of collective simulation-based TSPs is CITT. This large software package was developed during a series of three ARI projects from 1997 to 2001 (Flynn et al., 2001; Gossman et al., 1999; Gossman et al., 2000). The purpose of these projects was to design and develop a system enabling trainers to maximize the effectiveness of unit training in the CCTT. The products included a desktop software application, a Web Site, and two information videos. The CITT software application included detailed information on training in the CCTT, a library of over 50 CCTT exercises and TSPs, guidance and tools for creating and modifying

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TSPs, and software for developing exercise initialization files (the CCTT Exercise Initialization Tool or CEIT).

As CITT was developed several rounds of formative evaluation were conducted with representative members of the user population. Users' responses were generally positive, and CITT was refined repeatedly based on users' suggestions. In 2001, CITT was transitioned to the Project Manager – Combined Arms Tactical Trainer, and the desktop application was fielded to six CCTT sites. It appears that this initiative has not been sustained, and that CITT is utilized little today.

The CITT projects were an ambitious undertaking that resulted in several useful products. It may be instructive to examine why these products are little utilized today, to identify lessons learned for future TSP modification tools. Two general observations are provided here; personnel involved in development of future TSP modification tools should review the CITT reports for additional ones. One relevant observation is that, despite repeated efforts to make CITT easy to use, it was still somewhat cumbersome, especially for the creation of TSPs. Development of training in general and creation or tailoring of collective TSPs in particular is a complex process, involving the integration of numerous elements. The creation of a new TSP in CITT required several hours of effort, even with extensive supporting tools available; modification took an hour or more, depending on its extent. The CITT projects made significant progress toward but did not fully meet the challenge of making TSP creation and modification easy. The difficulties encountered in these projects dealing with one dedicated training environment will be increased many times in the future context of multiple training environments.

Another relevant observation is that at the time of the development of CITT, there was insufficient command emphasis on training in CCTT and using tools such as CITT to gain maximum benefit from that training. Commanders placed greater emphasis on training exercises conducted in the field than on those conducted in simulation facilities such as CCTT. Rather than using CITT, unit leaders and simulation managers found it easier to start with a small set of exercises and modify them "on the fly" as they saw fit. This reduced the preparation time and burden for training exercises, but whether it allowed maximum benefit to be derived from training is arguable. Establishing appropriate command emphasis and user acceptance may be even more challenging in the Future Force environment where training is intended primarily to be embedded on operational networks. Commanders must be led to believe that embedded training will not interfere with their operational systems, and that TSPs help ensure this.

Summary. For a number of interacting reasons, the capability to tailor or modify Future Force TSPs is very important. However, the CITT experience and the complexities of Future Force training environments indicate that it will likely be a long time before TSP tailoring becomes an easy, mostly automatic process that can be accomplished by unit personnel deploying frequently and rapidly. Consideration should thus be given, at least initially, to controlling tightly and limiting the TSP modifications that can be made by unit personnel, and to dedicating HSOC or TRADOC resources to managing TSPs and changes to them. Eventually the concept of modifiable TSPs should be broadened to adaptive TSPs, or ones that adjust in a largely automatic manner to various aspects of the training environment, such as the delivery

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media and synthetic natural environment available. But much work is needed before that goal can be achieved.

Reach

Reach has been defined as "...a virtual and collaborative strategy to access, share, and disseminate information in support of intelligence, maneuver, and logistics regardless of distance, time, or echelon" (Custer, 2003). The participants in the eTSP survey indicated that training in the future should also be supported by reach, since they ranked this capability as a close second to TSP modification in importance. The O&O (TRADOC, 2004a) identifies reach to remote knowledge centers as an important embedded training capability, and it lists several resources that training units will reach to. The ORD (UAMBL, 2004) specifies the requirement for "on-board" training products to link or reach to repositories to obtain updates, to access additional products, or to exchange products between training centers. One could argue whether reach is a function contained in TSPs, in the training management system, or in the overall FCS family of systems, but it is clear that the capability to exchange information through reach with distant nodes is an important one to include in Future Force TSPs.

Bi-directional reach. In the past reach has primarily been thought of as reach back; i.e., units at a forward location request information or other support from elements that are not as far forward. But reach can also extend forward; personnel at rear locations may reach forward to deployed elements for information of various sorts. Reach is thus a distributed, collaborative information-sharing process, as indicated in the definition above.

Reach must be designed to work over operational networks, while minimizing concerns such as bandwidth and signal propagation. It seems likely that Future Force units will take as much support as possible with them, minimizing the need for reach. In the case of collective TSPs, unit leaders will analyze the anticipated mission(s) and load relevant TSPs on unit computers. Modifications or updates to these TSPs, along with additional TSPs that may prove to be needed, will be provided to the unit through reach, probably during lulls in operations. Data from training exercises and modifications made to TSPs by unit personnel will be sent back through the same reach mechanism. Collective TSPs will include links to IMI and doctrinal references to ensure individuals complete preparatory or remedial training as required for participation in collective exercises. Whether TSPs and associated materials are loaded on unit computers or accessed through reach should be largely transparent to most unit personnel. The only difference may be the time required to access materials.

Reach nodes. A deployed Future Force unit could potentially conduct reach in support of training with many sources or nodes. The O&O (TRADOC, 2004a) lists many nodes that a unit may reach to, including remote distributed depositories, remote knowledge centers, the HSOC, institutional resource centers, subject matter experts, and the Army Knowledge Enterprise. A unit may also send training information back (including performance data, lessons learned, and TSP modifications) that is of interest to numerous nodes or agencies, including training institutions and repositories such as the Center for Army Lessons Learned.

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Numerous technologies are available and rapidly evolving to support distributed information search, retrieval, and dissemination (Wall, Elms, Biggers, & Sticha, 2004). Future Force units could potentially access information from and provide information to many nodes through future versions of the Internet. The key will be to ensure that unit personnel gain access to information they need as quickly as possible, while not being burdened with providing information back to numerous nodes. To achieve this it seems it will be necessary to establish a gateway or channel for a deployed unit's reach activities. Unit personnel will then conduct reach activities primarily with one node rather than many. At least in the case of training, an appropriate gateway will be the HSOC.

The HSOC is designed to be a portion of a Future Force Unit of Action that does not deploy, at least not as far forward as the main body. During a prolonged deployment, unit personnel may rotate between the HSOC and deployed elements. This will help ensure that HSOC personnel have a thorough understanding of deployed elements' requirements, including training needs. The HSOC could serve as a conduit for providing TSPs and updates to deployed elements, and for collecting data and lessons learned for distribution to appropriate agencies. The HSOC could also monitor and support deployed elements' training activities, perhaps filling roles such as observer, controller, coach, or role player from a distance. Until truly adaptive TSPs are available, the HSOC could accomplish many of the TSP modification activities discussed previously. The HSOC should be a key player in the training of Future Force units.

Simulated Operating Environment

The eTSP CD and survey addressed the capability to employ intelligent agents to substitute for missing members of the training audience. Reviews of current versions of acquisition documents, eTSP survey responses, and the TCC indicate that the definition or scope of this capability needs to be expanded considerably to include all aspects of the simulated operating environment (SOE). The capability needs to address all aspects of the training environment that are not physically present and are thus created synthetically. This may include the terrain on which training is conducted, environmental conditions (weather, light, etc.), entities (weapons platforms, sensors, etc.) operating on or above the terrain, weapons effects, and personnel in or outside the training unit.

Aspects of the SOE. One key aspect of the SOE is the use of databases to create and manage the synthetic natural environment for training exercises, including terrain (land and water), features on terrain (vegetation, soil types, etc.), and environmental conditions (weather, time of day, etc.). To support training of Future Force units, terrain databases must be readily available or rapidly creatable for all parts of the world. Units will need to be able to apply all appropriate environmental conditions to synthetic training areas. As indicated previously, adapting TSPs for different terrains or environmental conditions is not as simple as taking a training exercise from one piece of simulated terrain and dropping it on another. Relative positions of entities, control measures, movement patterns, and many other factors may need to be adjusted.

Synthetic entities operating on or over simulated terrain are generally created through computer-generated forces (CGF) or SAF. In Future Force training exercises a wide variety of

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platforms, systems, and units will need to be simulated through SAF, representing friendly (JIM) and opposing forces as well as neutral entities. This will include man-made environmental effects, such as smoke, minefields, and impacts of rounds. Collective TSPs will need to include or have ready access to data required for initializing SAF entities at the beginning of an exercise, as well as for representing the interactive behavior of dynamic entities during the exercise.

One particularly important and challenging aspect of SAF is the intelligent representation of individual human beings. This includes the use of intelligent agents to represent members of the training audience who are not participating in an exercise because they are not present or adequately prepared. It also includes representation of individuals in adjacent or higher units with whom interaction is required during a training exercise. To accomplish some training objectives it may also include representation of opposing or neutral individuals. The provision of humans adequately prepared to serve as role players is a heavy burden for many training exercises, and simulation of these individuals through SAF would be very beneficial. In recent years great advances have been made in the capability of SAF to realistically represent the behavior of weapons platforms and units. But it will be many years before SAF in the form of intelligent agents will realistically and cost-effectively represent the behavior of individual human beings. For some time collective TSPs will need to include instructions and scripts for human role players to support training exercises. In the Future Force at least some of these individuals may come from the HSOC.

Integration of the SOE. To support collective exercises, elements of the SOE must not only behave individually in a realistic fashion. They must also behave interactively with each other and with real elements or entities. The O&O (TRADOC, 2004a) indicates that the simulation of operational data not available from actual data sources is a key capability of embedded training. It also identifies the integration of simulated and actual data as a requirement. As one example, a training exercise involving the employment of sensors may include data from real sensors emplaced on or above real terrain, along with simulated sensors operating on virtual terrain. The embedded training system must integrate these real and simulated data inputs on a WMI display as if all the inputs were real. As another example, information during an exercise may come from real unit members and from surrogate members represented in the near term through human role players and in the long term through intelligent agents. The information must be provided so that the training audience doesn't know which elements are real and which are simulated.

Another example of the required interaction of real and simulated data is the representation of degraded modes of operation. The ORD (UAMBL, 2004) and the O&O (TRADOC, 2004a) indicate that the embedded training system must simulate faults and errors to allow training in such modes. Future Force TSPs must thus incorporate the capability to simulate operational systems running normally, running partially or abnormally, or not running at all. The integration of data into Future Force TSPs to drive simulation-based collective exercises will not be a simple matter.

Performance Measurement

Many would argue that training cannot be effective without performance measurement and feedback. Yet performance measurement was ranked fourth in the list of five capabilities in the eTSP survey. This may reflect the perceived relative importance of other factors, as well as the challenges in measuring human performance during collective exercises. The ORD (UAMBL, 2004) indicates that collection of training data is essential for analyzing performance and producing feedback. The O&O (TRADOC, 2004a) identifies automated evaluation of performance against task standards as a key capability of embedded training. It also describes training feedback as including the following general activities: collecting and recording performance data, evaluating performance and providing feedback on it, and aggregating performance records over time.

Collecting performance data. In simulation-based training exercises the collection and recording of performance data is often thought of as a data logging function. A data logger is generally a software service that records all electronic transmissions or packets during a simulation exercise, supporting later playback or recreation of the exercise. The logged data may also be analyzed to support displays used in AARs. Since Future Force collective training exercises are expected to be conducted primarily among distributed participants over operational networks, the potential exists for automatically capturing relevant performance measures simply by recording network traffic.

For various reasons, the future collection of performance measures may not be quite that simple, and the collection of network data may not tell the whole story. Not all information transfer may occur over the network. For example, information will likely be exchanged verbally between personnel over a radio, over an intercom, or face-to-face. Lickteig, Sanders, Durlach, and Carnahan (2004) found verbal communication within a command group to be near continuous in a Future Force mission execution environment. It will thus be necessary to collect (or at least overhear) voice transmissions, some of which do not occur over a network. In order to assess areas such as situational awareness, it will be necessary to record what information a person had access to at particular times, such as which files were open or which screens were being displayed. The degree to which operational systems can reasonably be instrumented to record such data remains to be determined. And that may not tell the whole story; the fact that a file was open or a screen was displayed does not guarantee that it was being looked at and understood.

The collection of performance measures in the command and control arena is a complex undertaking that in the past has relied heavily on trained observers. Future conduct of exercises over operational networks may lead to more objective and automated data collection with less reliance on observers, but it is expected that observational data will still be needed for some time to develop a complete understanding of performance. Future Force TSPs will thus need to include tools and procedures for observers (particularly observers who may be monitoring from a distance) as well as procedures for data logging.

Providing performance feedback. The primary means of providing feedback on performance in collective training exercises is the conduct of AARs. There is a continuing need

for a standard AAR interface using standardized AAR displays (TRADOC, 2004a). In the future AARs will increasingly be conducted in distributed mode, and there will likely be less time available for them. This may lead to less reliance on replay of major portions of an exercise, with more focus on replay of short segments and presentation of specific performance measures or indicators. Such measures will be needed not only to support AARs, but also to support rapid provision of performance feedback during active coaching while an exercise is ongoing or briefly paused. Measures also must support "take-home packages" for later study by exercise participants and to provide performance results for archiving in training data repositories.

Given the anticipated increasing reliance on the efficient collection and presentation of specific performance measures, a key area for future research is determination of what these measures are. Issues of the key performance measures to gather during collective exercises and the best ways to display them during AARs have been addressed at least since attempts to develop semi-automated AAR tools for the Simulation Networking system (Meliza, Bessemer, & Tan, 1994). Much work remains to be done in this area, especially for complex command and control performance (Holden, Throne, & Sterling, 2001; Throne, Holden, & Lickteig, 2000). This includes the need to specify detailed objective standards for Future Force performance; such specification needs to be accomplished as part of ongoing Future Force task analysis efforts. Provision of collective performance feedback for the Future Force needs to include more than exercise replays and summary displays to support AARs. It needs to include specific performance measures that are potentially automatable.

Archiving performance records. Performance results for Future Force individuals and teams will need to be stored in a readily accessible repository. This will enable the training management system to determine what training exercises have been completed successfully and what training needs to be completed next. The establishment of skill retention standards will also enable the training management system to determine when exercises need to be repeated for refresher purposes. In addition to directly supporting training management for individuals and teams, archiving of performance results will support quality control of training. For example, if many participants are having difficulty with a particular exercise, training managers should be alerted to examine the TSP being used, including the performance measures and standards. Recording the results of high-fidelity embedded training exercises may also lead to the identification of lessons learned and tactics, techniques, and procedures that can be applied during operations.

Pretests and Selection Criteria

This was the lowest ranked of the five capabilities included in the eTSP survey, but several participants (including two who gave it the lowest ranking) described it as an important one. The O&O (TRADOC, 2004a) mentions the need for Future Force TSPs to address identified weaknesses in individual and collective skills. Such identification can be achieved through examining archived performance records, selecting training exercise participants based on those records or other criteria, or administering a pretest before an exercise begins.

Several respondents to the eTSP survey downgraded the importance of this capability, indicating that leaders should know the abilities of their Soldiers and there is little harm in

providing challenges in training. At least in stabilized units, leaders should know the general abilities of their subordinates, but they may not know whether subordinates possess the specific knowledge and abilities required for a particular exercise. Also, in the Future Force environment leaders may train with a variety of individuals and elements (including JIM elements) with which they are not familiar. Finally, the harm in unprepared personnel participating in collective exercises is that not only will they not perform to standard, they may also interfere with the performance of and training benefit to prepared personnel.

This capability admittedly is largely a training management function and is the least important of the capabilities discussed here. But, as discussed above, there are reasons for keeping this capability as a distinctly identified one for Future Force TSPs. Provision of this capability will supplement leaders' abilities to know their subordinates' preparedness for training, and will help ensure that training resources are used effectively.

Comparison with Training Common Components

As mentioned previously, managers of FCS acquisition have identified a list of TCCs providing an infrastructure for achieving embedded training for the Future Force. Seven TCCs have been identified and an eighth one is currently under assessment (Harrison, 2004). Since the potential eighth TCC (embedded Tactical Engagement Simulation System) is designed primarily to support live training rather than the command and staff exercises focused on in this paper, it will not be addressed here. The seven TCC of relevance here are:

- Training Management
- Exercise Management
- Scenario Development
- SAF-CGF
- SOE Management
- Data Logger
- AAR

A comparison of the seven TCCs with the five major capabilities addressed in this paper indicates that there is a generally close match, with differences in organization, wording, and emphasis. The seven TCCs are covered by the five capabilities, along with the training management system within which the capabilities are addressed. The TCCs make a distinction between training management and exercise management, with training management focusing mostly on performance record keeping and exercise management focusing on initiation and control of exercises. The five capabilities group all management activities into one higher level function. The TCCs describe TSP modification as scenario development, but more than development and modification of the scenario (e.g., modification of training objectives, performance measures, observer guidelines) will be required. The TCCs distinguish between SAF-CGF and SOE management, but the five capabilities address SAF-CGF as part of the SOE. Finally, the TCCs distinguish between data logger and AAR functions, but the five capabilities describe these closely related functions as one.

One important difference between the TCC and the capabilities discussed here is that, reach, one of the most important capabilities, is not addressed by the TCC. This may be due to reach being considered as a capability of the FCS system of systems, rather than of embedded training and TSPs. Reach will be needed to support many activities other than training, such as intelligence and logistics. But reach is such an important capability of Future Force embedded training that support of it should be included in any list of training components.

Conclusions

The concept of a TSP needs to transform as the Army transforms to a Future Force. The concept of integrating all the information and materials needed to support a training event needs to continue. But this integration will occur not in a physical, paper-based package. Rather, it will occur electronically as linked databases and files. This will allow future TSPs to be more accessible and adaptable than TSPs have been in the past. Borrowing from software terminology, it may be more appropriate at some point to think of a TSP as a training support application, integrating training support services.

Future TSPs must be developed and implemented within a training management system enabling key capabilities needed to support fully embedded training. Personnel involved in Future Force training development and reviews of FCS acquisition documents indicate that the two most important capabilities that must be provided are TSP modification and reach. Users need support for modifying a TSP as rapidly as possible to meet their training needs. This may include modification tools integrated with EPSS, support from the appropriate HSOC or training centers, and software adapting TSPs to available training environments as automatically as possible. In order to access fully integrated training services (including modification tools), users of a TSP must be able to reach or link from it to a wide range of nodes. To keep this process simple for and responsive to busy deployed users, it will probably be best to establish one dedicated pathway for a unit's reach activities. The HSOC appears to be the appropriate pathway, at least for training.

Other capabilities that are important to provide in future TSPs include access to the SOE, performance measurement, and pretests and selection criteria. The SOE will provide representations of the environment (eventually including intelligent representations of individual human beings) that are not physically present for training, along with the integration of real and simulated data. The performance measurement and feedback process is critical for training, and for the foreseeable future it must include the integration of data gathered automatically and through observation. This will support performance feedback to individuals and groups through AARs, as well as feedback to the embedded training system through data archiving. The implementation of pretests and selection criteria will help ensure that future training resources are used wisely.

A comparison of key future TSP capabilities with the TCC identified by managers of the acquisition of embedded training for the Future Force shows a close match. One concern is that reach is not addressed in the TCC. Reach is a capability that will support much more than training in the future, but it is so critical to achieving fully embedded training that it should be included in any listing of future training components.

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Appendix A

List of Acronyms

AAR	after action review
ARI	U.S. Army Research Institute for the Behavioral and Social Sciences
ASAT	Automated Systems Approach to Training
ATIS	Army Training Information System
CCTT	Close Combat Tactical Trainer
CD	compact disc
CEIT	CCTT Exercise Initialization Tool
CGF	computer-generated forces
CITT	Commanders' Integrated Training Tool
DA	Department of the Army
EPSS	electronic performance support system
eTSP	electronic training support package
FCS	Future Combat Systems
HSOC	Home Station Operations Center
IETM	interactive electronic technical manual
IMI	interactive multimedia instruction
IPT	Integrated Product Team
JIM	joint, interagency, and multinational
KPP	key performance parameter
LSI	Lead Systems Integrator
NRFTT	networked reconfigurable, full-task trainers
O/C	observer/controller
O&O	Operational and Organizational Plan
ORD	Operational Requirements Document
SAF	semi-automated forces
SME	subject matter expert
SOE	simulated operating environment
SOW	Statement of Work

TCC	training common component
TDDT	Training and Doctrine Development Tool
TRADOC	U.S. Army Training and Doctrine Command
TSP	training support package
TSS	Training Support System
UAMBL	Unit of Action Maneuver Battle Laboratory
UFD	Users' Functional Description
WMI	Warfighter Machine Interface

Appendix B

Electronic Training Support Package Survey

Future Force TSPs

After viewing the Electronic Training Support Package (TSP) CD to which this survey is attached, please answer the questions below. You can fax your completed form to ARI at Fort Knox (Comm (502) 624-8113, DSN 464-8113, ATTN: Dr. Burnside or Dr. Throne), you can request an electronic copy to complete and return (Billy.Burnside@knox.army.mil or May.Throne@knox.army.mil), or you can call to provide your answers over the phone (Comm (502) 624-2613/7046, DSN 464-464-2613/7046). If we have not heard from you within two weeks, we will attempt to reach you by phone or email to obtain your answers. Thank you.

1. The electronic TSP CD highlights the 5 capabilities of future TSPs listed below. Please provide your view of the relative importance of these capabilities by rank ordering them. Place a "1" by the capability you think is most important for Future Force collective training, a "2" by the next most important, etc.

_____ Pretest/selection criteria

_____ Rapid tailoring and modification

_____ Use of intelligent agents to substitute for team members

_____ Reach to central repositories

_____ Semi-automated performance measurement tools

2.a. Please explain briefly your reason(s) for your #1 ranking above.

_____

_____

b. Please check and explain briefly whether your #5 ranking above is:

_____ really important

_____ nice to have, but not really important

_____

_____

PT# 60-61

3. Please provide brief descriptions of any other capabilities that are important to include in TSPs for Future Force collective training. Also, indicate where any capabilities you list would fall in your importance ranking.

_____

_____

_____

4. Please describe briefly what you see as the biggest challenge(s) to providing TSPs rapidly to meet the collective training needs of Future Force units.

_____

_____

_____